Citation:

Kvaavik E, Andersen LF, Klepp KI. The stability of soft drinks intake from adolescence to adult age and the association between long-term consumption of soft drinks and lifestyle factors and body weight. *Public Health Nutr.* 2005 Apr;8(2):149-57.

PubMed ID: 15877908

Study Design:

Prospective Cohort Study

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

NEUTRAL: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To investigate the tracking of sugar-sweetened carbonated soft drinks intake from 15 to 33 years of age and the association of this long-term intake of soft drinks and lifestyle factors such as smoking, physical activity, added sugar intake, and total energy intake with body weight at 33 years of age.

Inclusion Criteria:

Recruitment was a part of the Oslo Youth Study with a baseline survey in 1979 for 5th - 7th graders from six schools in Oslo, Norway. Inclusion data is not otherwise specified.

Exclusion Criteria:

None identified.

Description of Study Protocol:

Recruitment School based surveys in six schools in Oslo, Norway for 5th to 7th grades.

Design: Prospective cohort study

- In 1979 a questionnaire at school was completed with a brief health examination measuring height and weight. The questionnaire included questions regarding soft drink intake, leisure-time physical activity, and smoking.
- Nearly identical surveys were conducted in 1981, 1991, and 1999.
- The 1981 data was used as baseline however data from 1979 was used for 76 subjects who did not participate in 1979.
- In 1991 and 1999 the surveys were postal surveys.

- Heights and weights were self-reported in 1999.
- A semi-quantitative food frequency questionnaire was used in 1999.
- An intervention (not described) was included and both the intervention and control groups were included in the data set. BMR was calculated.
- Low intake of carbonated soft drinks was defined as intake of ≤ 2 times per week in 1991 and ≤ 3 times/week in 1999.
- Long term low consumer was defined as a subject who reported low consumption in 1991 and 1999, long-term high consumer was defined as a subject who reported high consumption in 1991 and 1999, and inconsistent consumer was one who reported once as a low consumer and once as a high consumer.

Blinding used (if applicable) Not described.

Intervention (if applicable) Not described however, the intervention was not a part of this study design.

Statistical Analysis

- Unpaired t-tests and chi-square to compare drop outs and genders with respect to dependent and independent variables for each survey.
- Unpaired t-test and Pearson's bivariate correlation coefficient to track analyses; Pearson's bivariate correlation coefficients to compare sugar-sweetened, carbonated soft drinks intake categories; UNIANOVA to compare long-term low and high consumers of sugar-sweetened carbonated soft drinks with prevalence of leisure-time physical activity, smoking, dieting, and energy underreporting with mean intake of sugar-sweetened carbonated soft drinks, energy and sugar and mean BMI reported in 1999.
- Multiple logistic regression analyzed overweight and obesity in relation to consumption of sugar sweetened soft drinks during 1991 - 1999. Both an adjusted and unadjusted model for adolescent BMI are presented. Odds ratios adjusted for factors known to be associated with body weight, i.e. energy intake, physical activity, smoking, dieting and underreporting were determined. No interaction effects between the intervention group and the control group were found so the two groups were combined for analysis in this report.
- An analysis of attrition was conducted finding that the participants were older, more often female, and less likely to smoke. There were not differences between the participants and the drop outs regarding sugar-sweetened carbonated soft drinks intake, physical activity or BMI.

Data Collection Summary:

Timing of Measurements Baseline was conducted in 1979 and 1981, follow up conducted in 1991 and 1999.

Dependent Variables

- Body height and weight measured at baseline and self-reported thereafter. Used to calculate BMI.
- Prevalence of smoking obtained by self-report
- Leisure time physical activity obtained by self-report
- Added sugar intake obtained by self-report
- Total energy intake measured by semi-quantitative food frequency questionnaire in 1999, obtained by self-report

Independent Variables

- Sugar-sweetened carbonated soft drinks intake

Control Variables

Description of Actual Data Sample:

Initial N: 1086 subjects were invited to participate in 1979 with 6 lost to death, 115 lost due to unknown address, 21 refused to participate, and 29 emigrated resulting in 915 subjects.

Attrition (final N): 422 participated in all three time points (surveys) and 21 were excluded due to anorexia or bulimia nervosa or pregnancy for a total participation rate of 46%. Of the 422 participants 215 were women, 207 were men.

Age: At baseline mean age of women was 14.6 years (11.0 - 17.0 yrs range) and for men 14.7 years (11.0 - 17.0 yrs range), p = 0.362.

In 1999 mean age of women was 32.9 (31.0 - 35.0 yrs range) and for men 33.1 (31.0 - 35.0), p = 0.168.

Ethnicity: Norwegian

Other relevant demographics: not described

Anthropometrics: BMI at baseline for women = 19.8 $\pm$ 2.5 SD and 19.5 $\pm$ 2.6 for men, p = 0.542.

In 1999, BMI for women = 23.4 $\pm$ 4.1 and for men = 25.6 $\pm$ 3.9, p = <0.001.

Location: Oslo, Norway

Summary of Results:

Key Findings:

- At ages 25 (1991) and 33 (1999) women reported lower intake of sugar-sweetened carbonated soft drinks than men, p <0.001.
- The amount and frequency of consumption of sugar-sweetened carbonated soft drinks in 1999 was lower for those consuming these beverages less than 3 times per week in 1991 for both men and women. The correlation coefficient between frequency of drink intake in 1991 and 1999 was 0.33 and 0.44 for women and men respectively, p< 0.001 for both men and women.
- Tracking of soft drink intake between adolescence to adulthood was weak.
- No differences were see between the consumption groups for dieting or mean BMI 1999. The odds ratio of being obese in 1999 for long-term high consumers of sugar sweetened carbonated soft drinks, inconsistent consumers, and low consumers were not different.
- Covariation between long-term (1991 - 1999) high consumption of sugar-sweetened carbonated soft drinks for women (n=196) and the following lifestyle factors was significant: low physical activity (p = 0.029), intake of sugar-sweetened carbonated soft drinks per day (p<0.001), sugar intake per day (p<0.001), and % energy from sugar (p<0.001). No other lifestyle factors significantly correlated with long-term intake of the

beverages.
- Covariation between long-term (1991 - 1999) high consumption of sugar-sweetened carbonated soft drinks for men (n=192) and the following lifestyle factors was significant: increased prevalence of smoking ($p = 0.002$), increased amount of smoking ($p = 0.026$), sugar-sweetened carbonated soft drinks per day ($p<0.001$), energy intake per day ($p = 0.005$), sugar intake per day ($p<0.001$), % energy from sugar ($p<0.001$), and a lower ratio of energy intake to BMR ($p = 0.026$).

Author Conclusion:

There was a high stability of sugar-sweetened carbonated soft drinks intake from early adulthood (25 years of age) into later adulthood (age 33 years) for both men and women. Long-term high consumers of sugar-sweetened carbonated soft drinks had a higher energy intake, a lower proportion of the women were physically active and a higher proportion of men smoked regularly and had higher energy intake compared with long-term low consumers of soft drinks. There was not a significant association of long-term consumption of sugar-sweetened carbonated soft drinks and body weight.

Reviewer Comments:

Limitations of the study included:

- *Measures of soft drinks intake varied between surveys, non-sugar containing soft drinks were not separated from sugar containing soft drinks in the first survey.*
- *It was difficult to statistically adjust for all factors affecting weight because of the great variability in lifestyle difference they represent and a larger study would be required to fully adjust for all variables.*
- *Some underreporting of intake was suspected.*
- *It is suspected that there were more smokers among the drop-out group than the participant group in 1999.*
- *Data was used only for subjects who participated in all three surveys resulting in a relatively large attrition rate. Stratifying subjects by gender and by consumption of soft drinks resulted in relatively small groups which reduced statistical power.*
- *All data was self-reported with the exception of height and weight at the 1981/1979 survey.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions

1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	N/A
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes

3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	N/A

Validity Questions

1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	No
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	No
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	No
2.4.	Were the subjects/patients a representative sample of the relevant population?	???
3.	**Were study groups comparable?**	N/A
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	N/A
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	N/A
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A

3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	N/A
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	Yes
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	No
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A

6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	No
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	No
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	No
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	No
7.7.	Were the measurements conducted consistently across groups?	N/A
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes

10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes